800830

ENVIRONMENTAL LEVELS OF RADIOACTIVITY FOR THE OAK RIDGE AREA

(Report for Period, July - December, 1963)

Compiled by the

Applied Health Physics Section

Health Physics Division

OAK RIDGE NATIONAL LABORATORY

APPROVAL FOR RELEASE

Document: # Unnumbered (14 pages); Date ND;

Title/Subject ENVIRONMENTAL LEVELS OF RADIOACTIVITY FOR THE OAK RIDGE AREA (Report for Period, July - December, 1963)

Approval for unrestricted release of this document is authorized by the Oak Ridge K-25 Site Classification and Information Control Office, Martin Marietta Energy Systems, Inc., PO Box 2003, Oak Ridge, TN 37831-7307.

Irwin S Davis 1/29/93

K-25 Classification & Information Control Officer Date

#502

Introduction

Radioactive waste materials arising from the operation of atomic energy installations at Oak Ridge are collected, treated, and disposed of according to their physical states.

Solid wastes are buried in a Conasauga shale formation. This shale has a marked ability to fix radioactive materials by an ion exchange mechanism.

Liquid wastes which contain long-lived fission products are confined in storage tanks or are released to trenches located in the Conasauga shale formation. (The use of pits for disposal of liquid waste was discontinued as of November, 1962.) Low level liquid wastes are discharged, after preliminary treatment, to the surface streams.

Air that may become contaminated by radioactive materials is exhausted to the atmosphere from several tall stacks after treatment by means of filters, scrubbers, and/or precipitators.

This report presents data on the environmental levels of radioactivity for the Oak Ridge Area and compares the data with established maximum permissible concentrations.

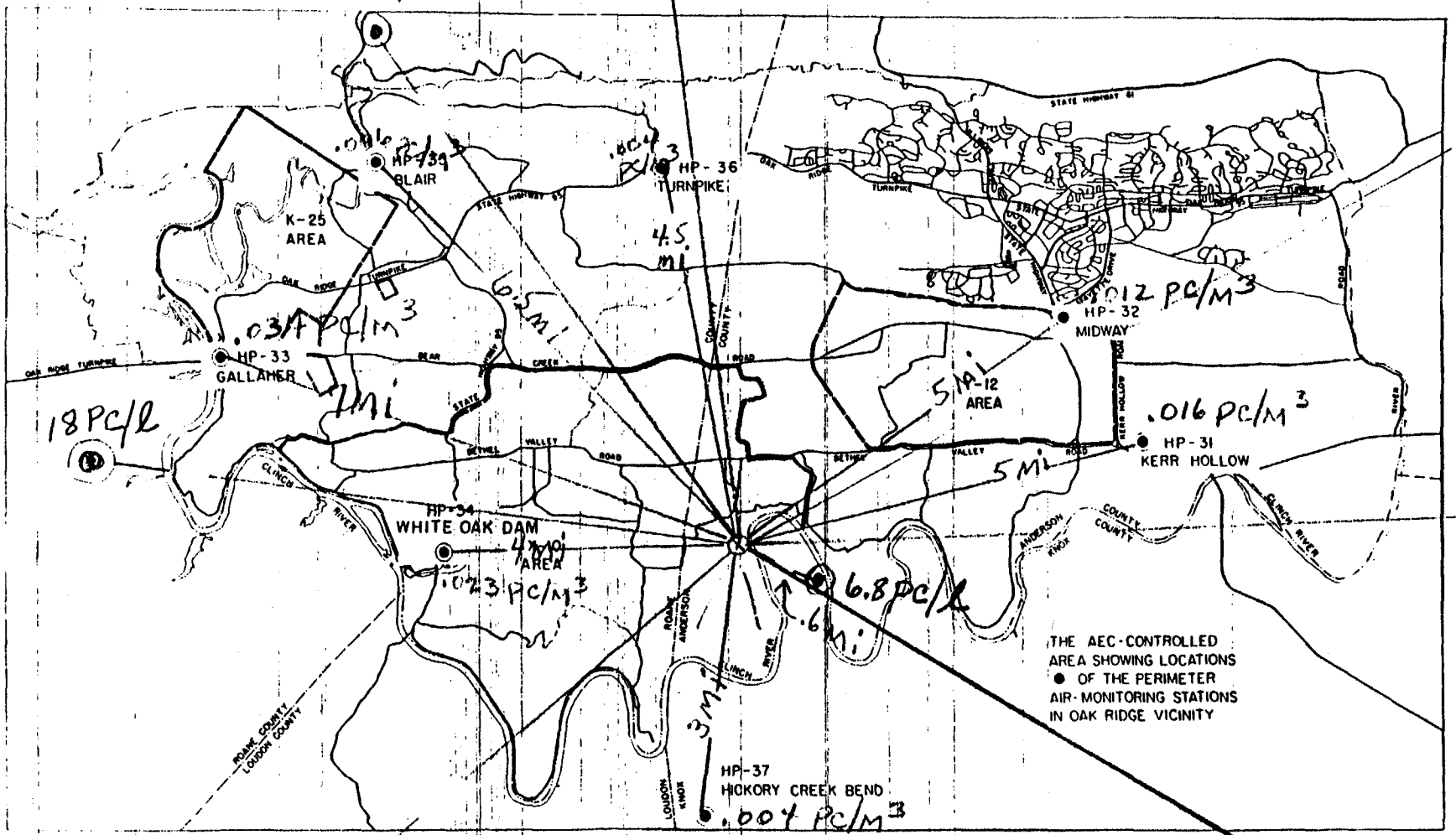
Air Monitoring

Atmospheric contamination by long-lived fission products and by fallout occurring in the general environment of East Tennessee is monitored by two systems of monitoring stations. One system consists of seven stations which encircle the plant areas (Fig. 1) and provide data for evaluating the impact of all Oak Ridge Operations on the immediate environment. A second system consists of seven stations encircling the Oak Ridge Area at distances of from 12 to 75 miles (Fig. 2). This system provides data to aid in evaluating local conditions and to assist in determining the spread or dispersal of contamination should a major incident occur. Sampling is carried out by passing air continuously through a filter paper. Data collected are accumulated and tabulated in average μc/cc of air sampled.

Atmospheric contamination by alpha-emitting materials, interpreted as uranium, is determined by taking continuous air samples at three locations on a five-mile radius from the Oak Ridge Gaseous Diffusion Plant (Fig. 3).

Water Monitoring

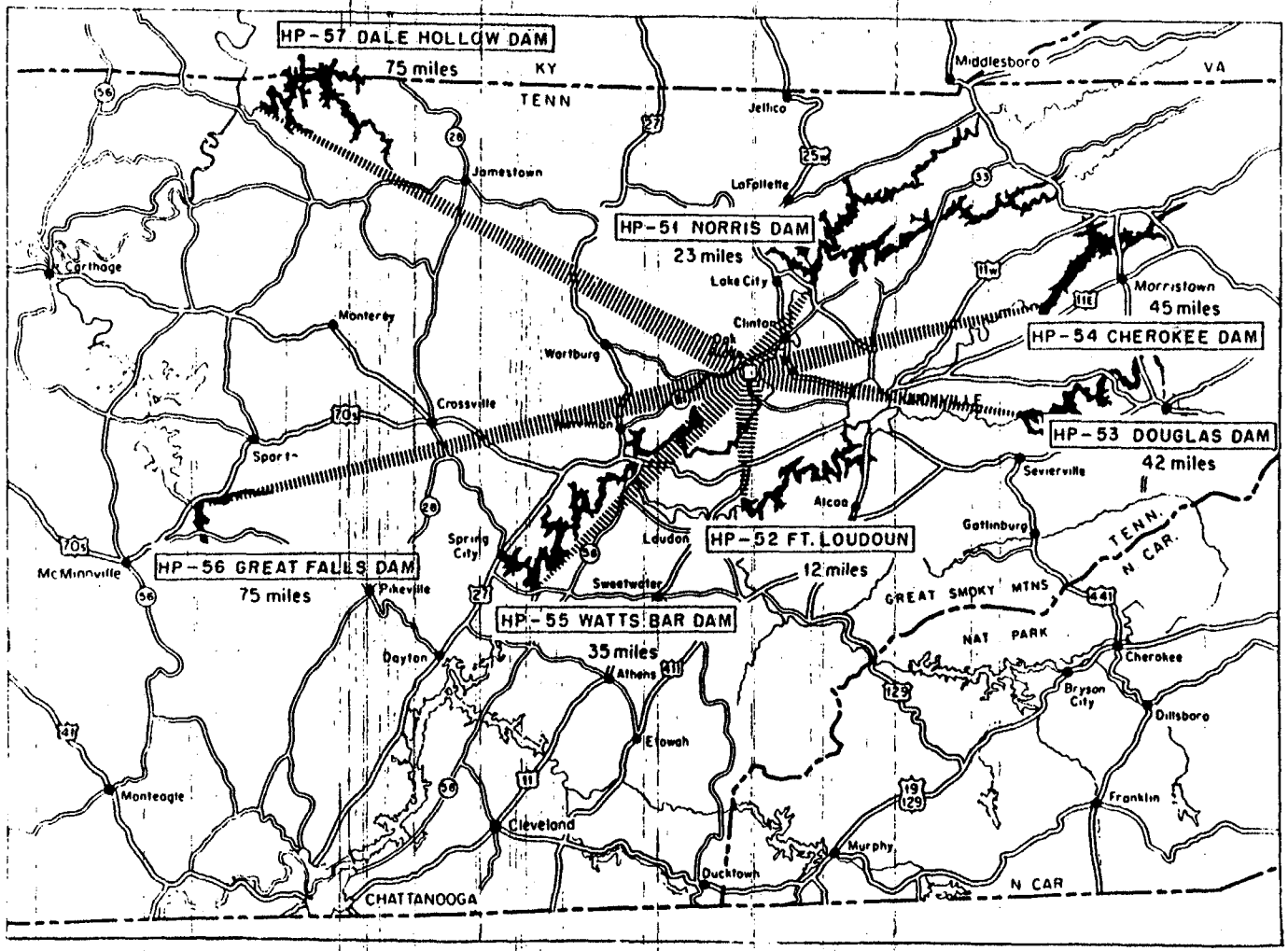
Large volume, low level liquid wastes originating at Oak Ridge National Laboratory are discharged, after some preliminary treatment, into the Tennessee River system by way of White Oak Creek and the Clinch River. Liquid wastes originating at the Oak Ridge Gaseous Diffusion Plant



STATION SITES FOR PERIMETER AIR MONITORING SYSTEM

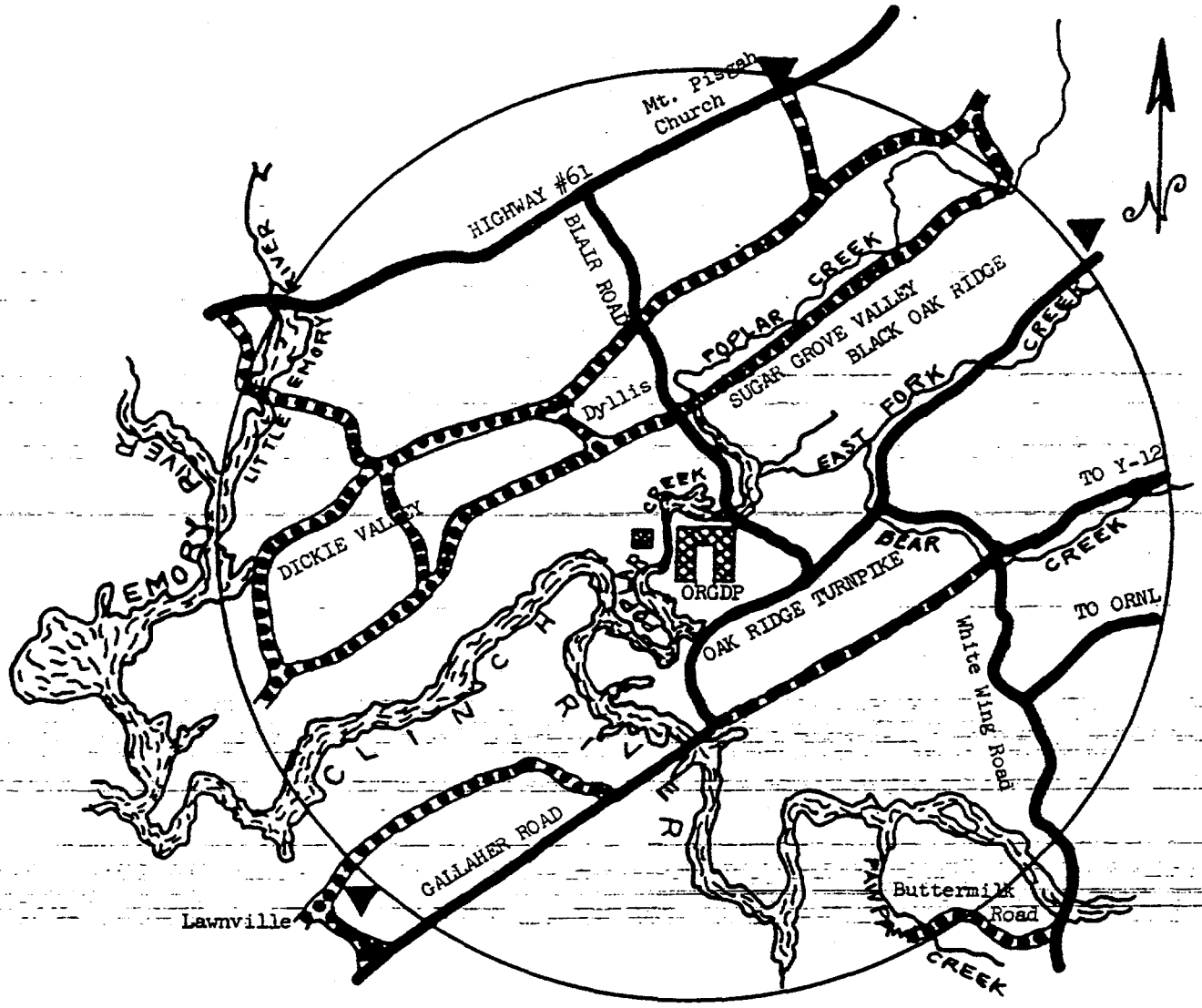
Figure 1

UNCLASSIFIED
ORNL-LR-DWG 35919R2



STATION SITES FOR REMOTE AIR MONITORING SYSTEM

Figure 2



SAMPLING POINTS OF OUTSIDE ENVIRONS -- ORGDP

AIR

▼ Sampling Location - Five Miles from Plant

Figure 3

and the Y-12 Plant are discharged to Poplar Creek and thence to the Clinch River. Releases are controlled so that resulting average concentrations in the Clinch River comply with the maximum permissible levels for populations in the neighborhood of a controlled area as specified by AEC Manual, Chapter 0524. The concentration of radioactivity leaving White Oak Creek is measured and concentration values for the Clinch River are calculated on the basis of the dilution provided by the river.

Radioactive liquid wastes are sampled at a number of locations as shown in Figs. 4 and 5. Samples are taken at a number of locations in the Clinch River, beginning at a point above the entry of wastes into the river and ending at Center's Ferry near Kingston, Tennessee. Stream gauging operations are carried on continuously by the United States Geological Survey to obtain dilution factors for calculating the probable concentrations of wastes in the river.

Samples are analyzed for the long-lived beta emitters, for uranium, and for the transuranic-alpha emitters.

Analyses are made of the effluent for the long-lived radionuclides only since cooling time and hold-up time in the waste effluent system is such that short-lived radionuclides are not present. The concentrations of those isotopes present in significant amounts are determined by analysis. A weighted average maximum permissible concentration for water, $(MPC)_w$, for the mixture of radionuclides is calculated on the basis of the isotopic distribution using the MPC values of each isotope as specified by AEC Manual, Chapter 0524.[1] The average concentrations of gross beta activity in the Clinch River are compared to the calculated $(MPC)_w$ values.

The concentration of uranium is compared with the specific $(MPC)_w$ value for uranium.

Gamma Measurements

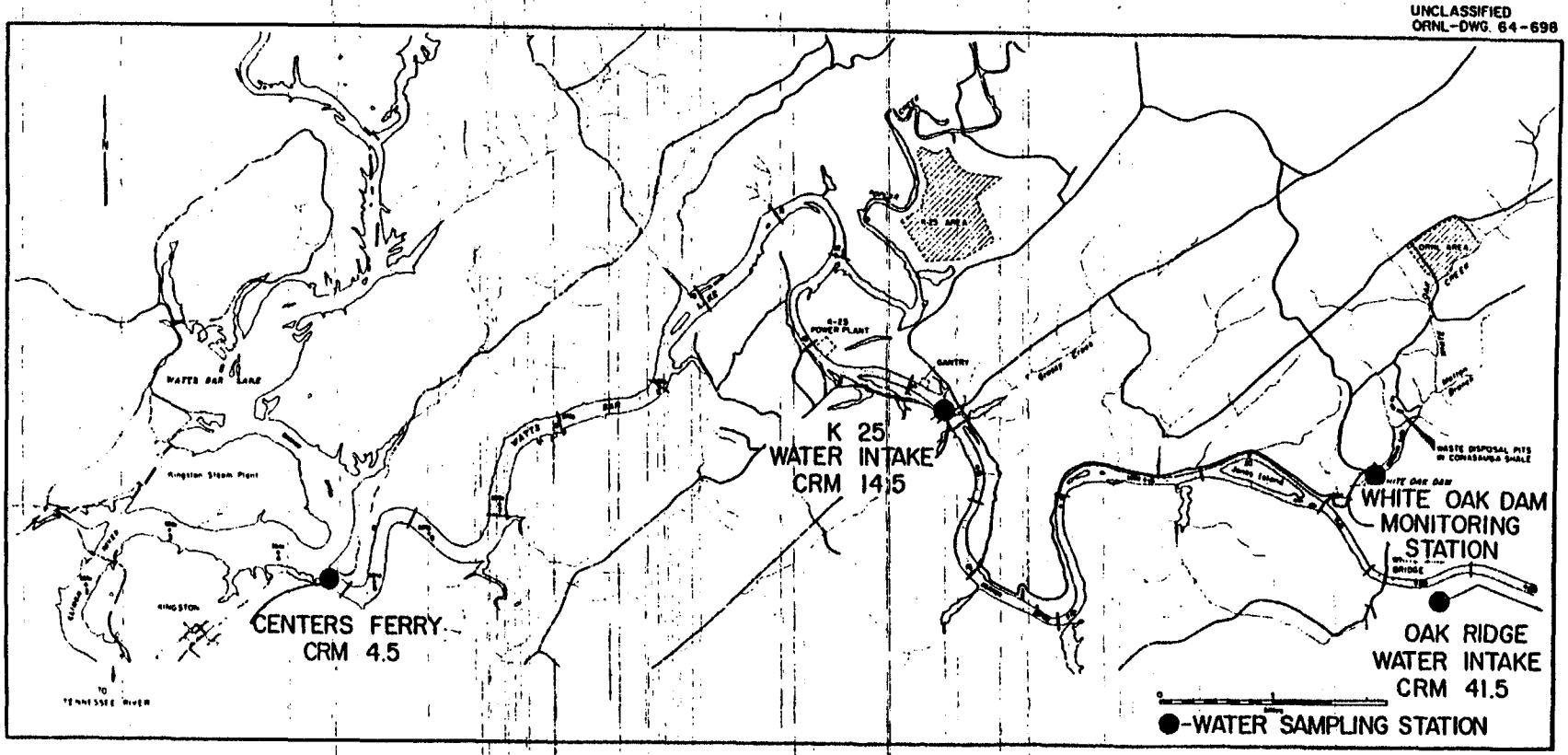
External gamma radiation levels are measured monthly at a number of locations in the Oak Ridge Area. Measurements are taken with a Geiger-Müller tube at a distance of three feet above the ground, and the results are tabulated in terms of mR/hr.

Discussion of Data

Data on the environmental levels of radioactivity for the second half of 1963 in the Oak Ridge and surrounding areas are presented in Table I through Table VI.

---

[1] AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.



WATER SAMPLING LOCATIONS

Figure 4

The average air contamination levels for gross beta activity, as shown by the continuous air monitoring filter data for the immediate and remote environs of the plants, were 2.0% and 2.4% respectively, of the maximum permissible concentration for populations in the neighborhood of a controlled area. These values are approximately a factor of three lower than those of the first half of 1963 but are not significantly different from the average of those measured in other areas of the United States and reported by the U. S. Public Health Service Radiation Surveillance Network for the period July through November, 1963.

The average air-borne alpha activity in the environs of the ORGDP, five miles from ORGDP, was 20% of the maximum permissible concentration for populations in the neighborhood of a controlled area.

The average concentrations of radioactivity in the Clinch River at Mile 20.8, the point of entry of most of the wastes, and at Mile 4.5, near Kingston, Tennessee, were 8.6×10^{-8} µc/ml and 4.4×10^{-8} µc/ml respectively. These values are 3.3% and 4.0% of the weighted average maximum permissible concentration $(MPC)_w$. The average concentration of transuranic alpha emitters in the Clinch River at Mile 20.8 was 5.9×10^{-11} µc/ml which is approximately 0.002% of the weighted average $(MPC)_w$ value.

The average activity of natural uranium materials in the Clinch River, reflecting the effects of all Oak Ridge Plants, was 0.01% of the $(MPC)_w$ for uranium.

Fall-out from weapons tests continues to result in increased concentrations of Sr^{90} and Ce^{144} in Clinch River water, Table IV, CRM 41.5, upstream from the point of entry of the wastes into the river.

External gamma radiation in the Oak Ridge Area averaged 0.023 mR/hr.

Conclusion

The air and ground contamination found in both the immediate and remote environs of Oak Ridge is due primarily to fall-out from sources other than local plant operations. From analysis of the data presented, it may be concluded that the Oak Ridge Operations contributed little to air or ground contamination in the neighborhood of the area controlled by the Atomic Energy Commission.

While some radioactivity is being contributed to the Clinch River by the release of low level radioactive liquid wastes from local operations, the resulting concentrations in the river are well below the maximum permissible concentration for populations residing in the neighborhood of a controlled area.

TABLE I

CONTINUOUS AIR MONITORING DATA

Long-Lived Gross Beta Activity of Particulates in Air

July - December, 1963

Station Number	Location	Number of Samples Taken	Units of 10^{-13} µc/cc			% of $(MPC)_a$
			Maximum[a]	Minimum[b]	Average	
		Perimeter Stations				
HP-31	Kerr Hollow Gate	26	68	5	22	2.2
HP-32	Midway Gate	26	69	5	23	2.3
HP-33	Gallaher Gate	26	49	3	16	1.6
HP-34	White Oak Dam	26	57	3	18	1.8
HP-35	Blair Gate	26	69	4	22	2.2
HP-36	Turnpike Gate	180[d]	66	4	22	2.2
HP-37	Hickory Creek Bend	26	61	4	20	2.0
Average					20	2.0
		Remote Stations				
HP-51	Norris Dam	26	59	5	23	2.3
HP-52	Loudoun Dam	25	91	4	27	2.7
HP-53	Douglas Dam	25	78	4	24	2.4
HP-54	Cherokee Dam	26	74	6	27	2.7
HP-55	Watts Bar Dam	26	72	5	23	2.3
HP-56	Great Falls Dam	26	75	5	24	2.4
HP-57	Dale Hollow Dam	26	56	5	22	2.2
Average					24	2.4

[a] Maximum weekly average concentration.

[b] Minimum weekly average concentration.

[c] $(MPC)_a$ is taken to be 10^{-10} µc/cc as specified in AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

[d] Samples collected on daily schedule beginning 5/7/62. Maximum and minimum daily average concentrations were 90 x 10^{-13} µc/cc and 3.0 x 10^{-13} µc/cc respectively.

TABLE II

OAK RIDGE GASEOUS DIFFUSION PLANT AIR MONITORING DATA

July - December, 1963

Distance from Center of Plant	Type of Analyses	No. of Samples*	Units of 10^{-13} µc/cc					
			Direction from Plant			Average	$(MPC)_a$	% $(MPC)_a$
			North	North East	South West			
5 Mile Radius	Gross Alpha	1418	2.5	5.0	2.5	4.0	20	20

* Normal Sampling Frequency: Continuous, averaged over 8 hours.

TABLE III

CALCULATED AVERAGE CONCENTRATION OF RADIOACTIVITY
IN THE CLINCH RIVER AT MILE 20.8

July - December, 1963

Number of Samples Taken	Units of 10^{-7} µc/cc			% of $(MPC)_w$
	Maximum[a]	Minimum[b]	Average	
182	4.6	0.08	0.86	3.3

[a] Maximum weekly average.

[b] Minimum weekly average.

TABLE IV

AVERAGE CONCENTRATION OF MAJOR RADIOACTIVE CONSTITUENTS
IN THE CLINCH RIVER

July - December, 1963

Location	Units of 10^{-8} µc/ml								% of
	Sr^{90}	Ce^{144}	Cs^{137}	$Ru^{103-106}$	Co^{60}	Zr^{95}-Nb^{95}	Average Beta Activity	$(MPC)_w$ [a]	$(MPC)_w$
Mi. 41.5[b]	0.15	0.13	0.04	0.50	0.02	0.05	0.89	56	1.6
Mi. 20.8[c]	0.14	0.01	0.13	2.8	0.21	0.04	8.6	260	3.3
Mi. 4.5	0.36	0.16	0.16	3.4	0.23	0.07	4.4	110	4.0

[a] Weighted average $(MPC)_w$ calculated for the mixture using $(MPC)_w$ values for specific radionuclides specified by AEC Manual, Chapter 0524, Appendix, Annex 1, Table II.

[b] Sampling station moved from Clinch River Mile 33.2 to Mile 41.5 about January 1, 1962.

[c] Values given for this location are calculated values based on levels of waste released and the dilution afforded by the river; they do not include amounts of radioactive material (e.g., fall-out) that may enter the river upstream from CRM 20.8.

TABLE VI

EXTERNAL GAMMA RADIATION LEVELS

mR/hr

July - December, 1963

Station Number	Location	July	Aug.	Sept.	Oct.	Nov.	Dec.	Average
1	Solway Gate	0.038	0.040	0.017	0.023	0.024	0.017	0.026
2	Y-12 East Portal	0.025	0.036	0.023	0.022	0.018	0.014	0.023
3	Newcomb Road, Oak Ridge	0.036	0.034	0.015	0.018	0.014	0.014	0.022
4	Gallaher Gate	0.042	0.043	0.020	0.023	0.019	0.018	0.028
5	White Wing Gate	0.017	0.022	0.014	0.014	0.013	0.012	0.015
Average		0.031	0.035	0.018	0.020	0.018	0.015	0.023

Note: These readings were taken with a calibrated Geiger-Muller tube at a distance of three feet above the ground.

The background in the Oak Ridge area in 1943 was determined to be approximately 0.012 mR/hr.

ChemRisk Document Request Transmittal Form

(This section to be completed by ChemRisk)

S Sandberg / ISD
Name Division is requested to provide the following document

Address _____

Date of Request 12/10 Expected receipt of document 12/21

Title of requested document Env Levels of Radioactivity

_____

_____

Document Number ~~800814 - 800831~~ 25 800830

Access Number of Document _____ Date of Document 1962-1966

(This section to be completed by Derivative Classifier)

Derivative Classifier R. G. Jordan Phone 4 1645

Date document transmitted to Dr. Quist 1/13/93 1/29/93

Date release received from Dr. Quist OK 082 1/29/93

PUBLIC RELEASE STAMP attached to each copy of document (YES NO)

Date document sent to reproduction _____ Expected Return _____

Delivered to DRC by _____ Date _____

(This section to be completed by DRC)

Received by DRC _____ Date _____

Processed _____

Mailed _____

1993 FEB -3 PM 5:54

OAK RIDGE K-25 SITE DOCUMENT RELF[illegible] FORM

Rec'd K-25CO: 1/29/93
cc: JLamb
File-K-25CO-RC(4710)
AS Quist, 2/1/93

Person requesting release JENNIFER LAMB (CHEMRISK) 4-0745

Mailing Address K-1200 MS-7262 ...on

Date by which release is required ...idard processing time is 5 working days.

Some documents require special review and ti... ...ime will be longer).

Note: Two copies of the document must generally be provided to the Classification ...d Information Control Office with this request. Only one copy of photos and videotapes is required. Documents that include photos must be accompanied by "originals" of the photos.

Approval of request for Classification and Information Control Office to release document (department head or higher):

Signature: _____ Date _____

DOCUMENT DESCRIPTION (to be completed by requester)

Document number UNNUMBERED/800830 Pages 15

Document title ENVIRONMENTAL LEVELS OF RADIOACTIVITY FOR THE OAK RIDGE AREA (REPORT FOR PERIOD JULY - DECEMBER, 1963)

Author(s) (indicate other divisions or organizations, if applicable) APPLIED HEALTH PHYSICS SECTION (ORNL)

Document type (See Doc. Prep. Guide, Chs. 1 and 2, for definitions of document types):

☐ Formal Report ☑ Progress Report ☐ Informal R&D Report ☐ Abstract ☐ Drawing
☐ Administrative ☐ Correspondence ☐ Internal Technical Data ☐ Photo ☐ Other Visuals

☐ Journal Article (identify journal): _____

☐ Oral Presentation (identify meeting, sponsor, location, date): _____

Will oral presentation be published in program, booklet, brochure, etc.? ☐ Yes ☐ No ☐ Not Known

Will copies of the oral presentation be distributed ☐ before, ☐ after, ☐ during the meeting? ☐ No distribution will be made.

☐ Other (specify): _____

Purpose of release HEALTH STUDY FEASIBILITY PROJECT

Previously cleared documents containing similar information _____

Is copyrighted material contained in this document? (If present, attach release.) ☐ Yes ☑ No

Remarks _____

CLASSIFICATION INFORMATION (to be obtained by requester)

Was the work reported in this document funded, in whole or in part, by a classified program at Martin Marietta Energy Systems, Inc.?

☐ No ☐ Yes (Name of program: _____)

Is the subject area of this document closely related to a prior or current classified program at Martin Marietta Energy Systems, Inc.?

☐ No ☐ Yes Within the Department of Energy? ☐ No ☐ Yes

Name or Description of applicable program(s) _____

Additional remarks _____

This document contains no classified information.

Derivative Classifier signature T.C. Jones Date 1/14/93

DISTRIBUTION LIMITATIONS (If any) (completed by requester)

☐ Unrestricted, unlimited

Distribution may be limited because this document contains information that is:

☐ Unclassified Controlled Nuclear Information *	☐ Applied Technology *	☐ Export Controlled *
☐ Naval Nuclear Propulsion Information *	☐ Gov't Confidential Commercial Information *	☐ Proprietary
☐ Sensitive Nuclear Technology *	☐ Small Business Innovation Research *	☐ Official Use Only
☐ Safeguards Information *	☐ Cooperative R&D Agreement *	☐ Other

* Generally identified by sponsor

Remarks: _____

PATENT INFORMATION (completed by requester)

Does this document disclose any new equipment, process, or material? ☐ Yes ☐ No

If yes, list the patent significance and identify page number(s) and line number(s) in the space immediately following (or attach separate pages).

PATENT SECTION ACTION (completed by Patent Section upon request by the Classification and Information Control Office)

☐ Document may be released for publication ☐ Document must be reviewed by DOE Patent Group before release

☐ Document contains patentable information and may not be released at this time

Remarks _____

Patent Section Representative _____ Date _____

CLASSIFICATION AND INFORMATION CONTROL OFFICE ACTION (completed by Classification and Information Control Office)

Classification Office Action Taken: ☐ Not approved for release (see below) ☐ Approved for release with changes (see below) ☐ Approved for release without change

Classification Officer signature _____ Date _____

Technical Information Office Action Taken: ☐ Not approved for release (see below) ☐ Approved for release with changes (see below) ☒ Approved for release without change

to Clearlist.

Technical Information Officer Signature Gwen Smith TIO Date 1/29/93

Send to OSTI? ☐ Yes ☐ No Category Distribution: _____

UCN-87 BACK